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(54) Name of the invention: Method for the Formation of a Barrier Wall Onto a Substrate Plate

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(54) Name of the Invention

Method For the Formation of a Barrier Wall onto a Substrate Plate

(57) [Summary)

[Structure]

A method for the formation of a barrier wall onto a substrate plate that is appropriate for a plasma display device or a liquid crystal display device where the scanning is conducted through a plasma discharge, where in the space between the front surface of a glass plate 1, that has electrodes formed on it, and the molding material 3, the coating solution 21, which has as its main component a low melting point fine glass powder, is placed, and prior to the hardening of the coated solution 21, the molding material 3 and the glass substrate plate 1 are tightly adhered, and after the hardening, the molding material 3 is removed, and it is then annealed.

[Scope of the Patent Claims]

[Claim 1]

Method for the formation of a barrier wall onto a substrate plate characterized by the fact that it is a method where a barrier wall is formed on the front surface of a substrate plate, where a molding material is used that has at least on one surface indented parts that correspond to the shape of the barrier wall, and the substrate plate and the molding material have between them a coating solution, which contains a material that forms the barrier wall when it hardens (cures), in a non-hardened state, and the they are adhered and bonded so that the side of the molding material where the indented parts have been formed, is placed in contact with the substrate plate, and then the

coating solution is hardened and after that, the molding material is removed from the substrate plate, and the substrate plate with the transferred on it hardened coating solution is then annealed.

[Claim 2]

Method for the formation of a barrier wall on a substrate plate according to the above described Claim 1 of the present invention, characterized by the fact that on the front surface of the substrate plate the coating solution layer is formed and pressure is applied from the top of that layer so that the side of the molding material that has the indented parts formed on it is in contact with the substrate plate, and by that the substrate plate and the molding material are tightly adhered.

[Claim 3]

Method for the formation of a barrier wall on a substrate plate according to the above described Claim 1 of the present invention, characterized by the fact that the coating solution is filled into the indented parts of the molding material and after that the substrate plate and the molding material are tightly adhered so that the side of the molding material that has the indented parts formed on it is in contact with the substrate plate.

[Detailed Explanation of the Invention]

[0001]

[Technological Sphere of Application]

The present invention is an invention about a method for the formation of substrate plate that is appropriate for use in plasma display devices or liquid crystal devices where the scanning is conducted by plasma discharge.

[0002]

[Prior Art]

In the past, the formation of a barrier wall onto the front surface of glass substrate plates used as plasma display devices or liquid crystal devices where the scanning is conducted by plasma discharge, has been done as low

melting point glass paste has been coated by using the screening method with the predetermined width and height linear stripes of the predetermined pattern, and after that it has been annealed. However, because of the fact that it is required to ensure the stability of the plasma discharge it is necessary that the height of the barrier wall is approximately 0.2 mm, however, also, because of the fact that it is necessary to ensure the brightness of the display surface image, it is necessary that the width of the barrier wall be approximately 0.1 mm, and because of that, the formation of that wall by a one time screen printing is difficult and usually, the barrier wall has been formed by multiple layer printings. Because of that, the costs are increased, and also, due to the fact that it is necessary that the formation is conducted so that there is no generation of position variations over large surface areas, this method is limited by the fact that the barrier wall width must be narrow.

[0003]

[Problems Solved by the Present Invention]

The goal of the present invention is to suggest a method that solves the above described drawbacks that are associated with the previous technology, and a method where the costs of the formation of the barrier wall are reduced and where it is possible to make the width of the barrier wall be fine.

[0004]

[Measures in Order to Solve the Problems]

The present invention is an invention that has been conceived in order to solve the above described problems, and it is an invention that suggests a method for the formation of a barrier wall onto a substrate plate characterized by the fact that it is a method where a barrier wall is formed on the front surface of a substrate plate, where a molding material is used that has at least on one surface indented parts that correspond to the shape of the barrier wall, and the substrate plate and the molding material have between them a coating solution, which contains a material that forms the barrier wall when it hardens (cures), in a non-hardened state, and the they are adhered and bonded so that the side of the molding material where the indented parts have been formed, is placed in contact with the substrate plate, and then the coating solution is hardened and after that, the molding material is removed

from the substrate plate, and the substrate plate with the transferred on it hardened coating solution is then annealed.

[0005]

Here below, by using diagrams, the method for the formation of barrier wall according to the present invention will be explained. In Figure 1, 1 represents a glass substrate plate, 2 represents the coating solution, which has as its main component a low melting point glass fine powder in a hardened state, 3 represents the molding material, 4 represents the electrodes that have been formed on the surface of the glass substrate plate.

[0006]

As the substrate plate according to the present invention, different types of glass etc., can be used starting with soda lime silica type glass, etc.

[0007]

As the coating solution used according to the present invention, a solution is preferred that has as its main component a low melting point glass fine powder, because it is possible that by using that material and coating and annealing it a glass barrier wall is formed that has the predetermined width and height of the predetermined pattern.

[0008]

As the low melting point glass fine powder material, these are different glass frits. For example, it is possible to use glass formed from a composition that has as its main component any of the lead oxide, bismuth oxide, zinc oxide etc., as it has been pulverized, and it is necessary that it is a material that softens at a temperature that is lower than the softening point of the used glass substrate plate. Also, it is preferred that the thermal expansion coefficient is almost equal to that of the glass substrate plate so that there is no deformation of the glass substrate plate.

[0009]

As the coating solution that contains as its main component the low melting point fine glass powder material, a solution is used that has a structure

formed mainly from the low melting point fine glass material and a small amount of an adhesive agent. And as the adhesive agent, it is possible to use a photo-curable resin material or a thermo-curable resin material, however, the use of the photo-curable resin material is preferred because it is possible to shorten the time of the formation of the barrier wall by the molding material. As the photo-curable adhesive agent, for example, it is possible to use a mixed material containing 1-vinyl – 2- pyrolidon and N, N – dimethylacrylamide, etc., acrylic type adhesive agents.

[0010]

As the molding material used, it is possible to use flat plate shaped glass or metal that has protrusions and indentations (grooves) that have been formed on its front surface, however, in the case when a photo-curable adhesive agent is used in the coating solution, it is preferred to use glass molding material because of its excellent transparency properties. This is because of the fact that the electrodes that are formed on the surface of the glass substrate plate intercept the light and in this case it is not possible to irradiate light from the side of the glass substrate plate with these electrodes.

[0011]

Then, in order that at the time when the molding material is removed there is no breakage of the glass substrate plate or damage of the molding material, it is preferred to use a glass mold material that has been subjected to a chemical treatment with a thickness that is thinner than the glass substrate plate thickness. Then, when the die release properties of the protruded and indented shapes on the front surface are considered, it is desired that the sectional surface would have a ladder shape.

[0012]

Regarding the coating of the coating solution, it is a good option if it is directly coated onto the substrate plate and it is also a good option if it is coated on the molding material.

[0013]

Figure 2 is a diagram that shows the technological process in the case when first the coating solution 21 is coated onto the molding material 3, and the

indented parts of the molding material are filled. First, the coating solution 21 is coated onto the molding material 3, and a coating layer is formed on the surface of the molding material (Figure 2 (a)). After that, the excess coating solution 21, which has been placed on the surface of the molding material 3 is removed by a scraper, and the front surface of the molding material 3 is made to be flat (Figure 2 (b)). Then, after that, the glass substrate plate 1 is placed on the top of the molding material 3 (Figure 2 (c)).

[0014]

After that, it is reversed and the side of the molding material 3 where the indented parts have been formed, is tightly adhered to the glass substrate plate, and a coating and after that hardening was conducted, and after that, the molding material 3 is separated from the glass substrate plate 1 (Figure 2 (d)). And finally, the barrier wall 22, which has been formed from the coated by the hardening, is annealed and the glass material barrier wall is formed (Figure 2 (e)). Regarding the coating procedure for the coating of the coating solution onto the glass substrate plate, it is preferred to be conducted under reduced pressure environment in order to have good mold reproducibility properties.

[0015]

Figure 3 is a diagram that shows the technological process in the case when the coating solution is coated on the glass substrate plate. First, the coating solution 21 is coated thickly on the surface of the glass substrate material (Figure 3 (a)). After that, the side of the molding material which has the indented parts formed on it, is pressed on the surface of the glass substrate plate 1, and these are tightly adhered, and coated and then hardened (Figure 3 (b)). Then, next, the molding material 3 is separated from the glass substrate plate 1, and the excess coating solution 21 is taken away (Figure 3 (c)). And finally, the barrier wall 22, which has been formed from the coating solution and hardened, is annealed, and by that, the glass barrier wall is formed (Figure 3 (d)).

[0016]

In any of the cases shown in either Figure 2 or Figure 3, it is preferred that in order to improve the die release properties of the molding material, an

extremely thin layer of oil be coated on the front surface of the molding material.

[0017]

Regarding the tight adhesion between the substrate plate and the molding material, it is a good option if it is accomplished by any of the following methods: the pressure method whereby these are squeezed between two thick glass plates on both sides, or the method where the substrate plate and the molding material are placed in a bag manufactured from plastic and then vacuum is pulled and they are tightly adhered, etc.

[0018]

[Effect]

According to the present invention, a coating solution that has as its main component an adhesive agent containing low melting point fine glass powder is molded by a molding material, and then it is hardened and after that the mold is separated, and because of that it is possible to form a thick coated layer by a one time technological process, and it is difficult to generate the printing pattern thickening or destruction or gaps, which accompany the pattern variations, and consequently it is possible to form a barrier wall that has no gaps and has a fine thickness homogeneously over the entire surface area of a large surface area glass substrate plate.

[0019]

[Practical Examples]

[Practical Example 1]

The front surface of a soda-lime glass with a length of 60 cm, a width of 1 m and a thickness of 1.1 mm, is polished and the front surface is made smooth, and a light sensitive dry film is stacked and glued, and by using a prepared in advance photo mask a barrier wall pattern is transferred onto the surface of the film. This was developed and after that the remaining film was masked and by using the sand blasting method indented parts were formed uniformly over the whole body of the substrate plate, the film was removed and the whole body was immersed into a mixed solution comprised of

fluoric acid and sulfuric acid, and the front surface layer was etched and removed to a level of 2 microns, and after that, a chemical hardening treatment was conducted in a potassium nitrate molten salt and by that the molding material was manufactured. Especially, by immersing the molding material into a solvent agent where a lubricating oil has been added, a die release layer with a thickness of 10 nm or less was formed.

[0020]

The coating solution was prepared according to the following: to a powder glass whose main component is lead glass with a softening point of 400oC, a crystallization temperature of 515oC, a thermal expansion coefficient of 8.4 x 10 –6/oC, an acrylic type ultra-violet beam curable type adhesive agent was added and mixed at a ratio of approximately 10 % as a volume ratio.

[0021]

The prepared according to this molding material was introduced into a reduced pressure vessel and on almost all the surface of the one side a coating solution was coated and then it was taken out of the vessel and after that the coating solution was scraped by using a scraper. On the top of that, a soda-lime glass substrate plate with a length of 60 cm, width of 1 m and thickness of 2 mm, where an electrode layer, etc., have been formed in advance, was stacked and combined and in this state the composite was reversed and after that it was introduced into a bag manufactured from polyethylene, and vacuum was pulled into the bag and by that both materials were tightly adhered, and in this state from the side of the molding material, irradiation was conducted by using a high pressure mercury lamp, and by that the coating solution was hardened. After that, this was taken out of the bag, and the molding material was gradually separated from one end, and the obtained glass substrate material was heated inside an oven, and the adhesive agent was vaporized, and after that especially, it was heated up to a temperature of 520oC, and the powder glass was annealed and crystallized.

[0022]

By that, on the front surface of the glass substrate material it was possible to form uniformly over the whole surface a barrier wall with a thickness of approximately 80 microns, a height of 200 microns and at a pitch of 225 microns both in the longitudinal and in the transverse direction.

[0023]

[Practical Example 2]

The same glass substrate plate, molding material and coating solution as those used according to the Practical Example 1, were employed, and the technological process shown according to the presented in Figure 3, was followed, and by that a glass barrier wall was formed on the glass substrate plate. Then, the same glass substrate plate with the adhered on it barrier wall, was obtained as described in the above Practical Example 1.

[0024]

[Results From the Present Invention]

The display device obtained by using the glass substrate plate manufactured according to the method of the present invention, shows the described here below excellent characteristics.

[0025]

(1) The technological process is simple and also, it becomes possible to obtain fine detailed patterns, and because of that it is possible to ensure the decrease of the manufacturing costs and the resolution and brightness as a display.

[0026]

(2) Because of the high precision, it is possible to practically realize a barrier wall surface with only a few defects, and due to that it is possible to design an increase in the plasma discharge stability properties and a reduction in the flickering.

[0027]

(3) Because of the fact that at the location where there is no barrier wall formation, the surface is flat, it is possible to effectively direct the light from the back side to the liquid crystal panel side.

[0028]

Also, the method according to the present invention has the described here below results.

[0029]

(1) By the use of the photo-curable adhesive agent it is possible to shorten the time that is required for the cure (hardening), and it is possible to reduce the amount of the needed molding material.

[0030]

(2) By the appropriate use of molding material that is formed from glass that has been subjected to a chemical reinforcement at a small thickness, the reduction of the breakage of the glass substrate plate and the prolongation of the working life of the molding material, become possible.

[Brief Explanation of the Figures]

[Figure 1]

Figure 1 represents a sectional view diagram of the barrier wall formed according to the method of the present invention.

[Figure 2]

Figure 2 represents a schematic diagram showing the technological process for the formation of a barrier wall according to one practical example of the present invention.

[Figure 3]

Figure 3 represents a schematic diagram showing the technological process for the formation of a barrier wall according to another practical example of the present invention.

[Explanation of the Symbols]

1.....glass plate
2.....coating solution containing as its main component a low melting point fine glass powder, in a hardened state
3.....substrate material
4.....electrodes
21..... coating solution containing as its main component a low melting point fine glass powder
22.....barrier wall

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